Homestake Mining Company of California
560 Anaconda Road, Route 605 North
Milan, New Mexico 87021

May 9, 2019

Mr. Mark Purcell
Superfund Division (6SF)
U.S. Environmental Protection Agency - Region 6
1445 Ross Avenue, Suite 1200
Dallas, TX 75202

Re: Grants Reclamation Project
Preliminary ERT Assessment Results – Revision 1

Dear Mark,

Homestake is providing the attached Preliminary ERT Assessment Results Revision 1 prepared by Arcadis U.S. Inc. for your information. This revision incorporates modifications to the original memo based on comments received from the U.S. EPA and the NMED. If you have questions or comments, please contact me at (775) 397-7215, or at dlattin@barrick.com.

Respectfully,

Daniel Lattin, P.E.
Project Evaluation Manager
Homestake Mining Company of California

MEMO

To:

Mr. Daniel Lattin, P.E.
Project Evaluation Manager
Barrick Gold of North America, Inc.

Copies:

Arcadis U.S., Inc.
150 W. Market Street
Suite 728
Indianapolis
Indiana 46204
Tel 317 231 6500
Fax 317 231 6514

From:

Gregory Byer, L.P.G., P.E.

Date:

May 9, 2019

Arcadis Project No.:

CO000120.1901

Subject:

Preliminary ERT Assessment Results, Revision 1
2019 Background Assessment
Grants Reclamation Project, Grants, New Mexico

The purposes of this memo are 1) to present the preliminary results of the Electrical Resistivity Tomography (ERT) Assessment work, the plans for which were described in the document entitled, "WORK PLAN: 2019 BACKGROUND INVESTIGATION", dated February 13, 2019, 2) present the locations for two pairs of monitoring wells screened the alluvial aquifer (BK1 and BK2), and the rationale behind the selected locations in accord with Section 1.3, Data Needs and Study Objectives, of the referenced work plan, and 3) present the locations of two additional boreholes that will provide information on mineralogy (BK3) and depth to bedrock at two separate locations (BK4). Note that the wells will each be 2-inches in diameter and will have screen lengths that range from 5 to 10 feet (to establish sample points within material of predominantly coarse of fine size characteristics). The final presentation of the results of the electrical resistivity tomography, including documentation of field activities, data processing and interpretation work, will be incorporated in the final report outlined in Section 4.0 of the work plan.

This memo is a revision of the draft memo dated May 1, 2019. It incorporates modifications to the original memo based on comments received from the U.S. EPA and the NMED, verbally and in writing. The boring locations shown in this memo reflect the agreed-upon locations resulting from the most recent technical interchange held by teleconference held from 2:00 p.m. to 3:00 p.m. MDT on May 7, 2019.

Data collection was preformed from April 8 to 12, 2019. The procedures used were those outlined in the work plan. Arcadis conducted the ERT assessment as follows:

- Electrical resistivity data sets were collected along two roughly parallel east-west transects that span the alluvial channel. **Figure 1** (draft) provides the location of the two electrical resistivity lines. The locations were surveyed with a submeter accuracy DGPS unit. In both cases, data collection proceeded from west to east, and the numbers posted along the lines (dots every 20 feet) are in intervals of 100 feet. Final line lengths were 7709 and 7618 feet for Lines 1 and 2, respectively.

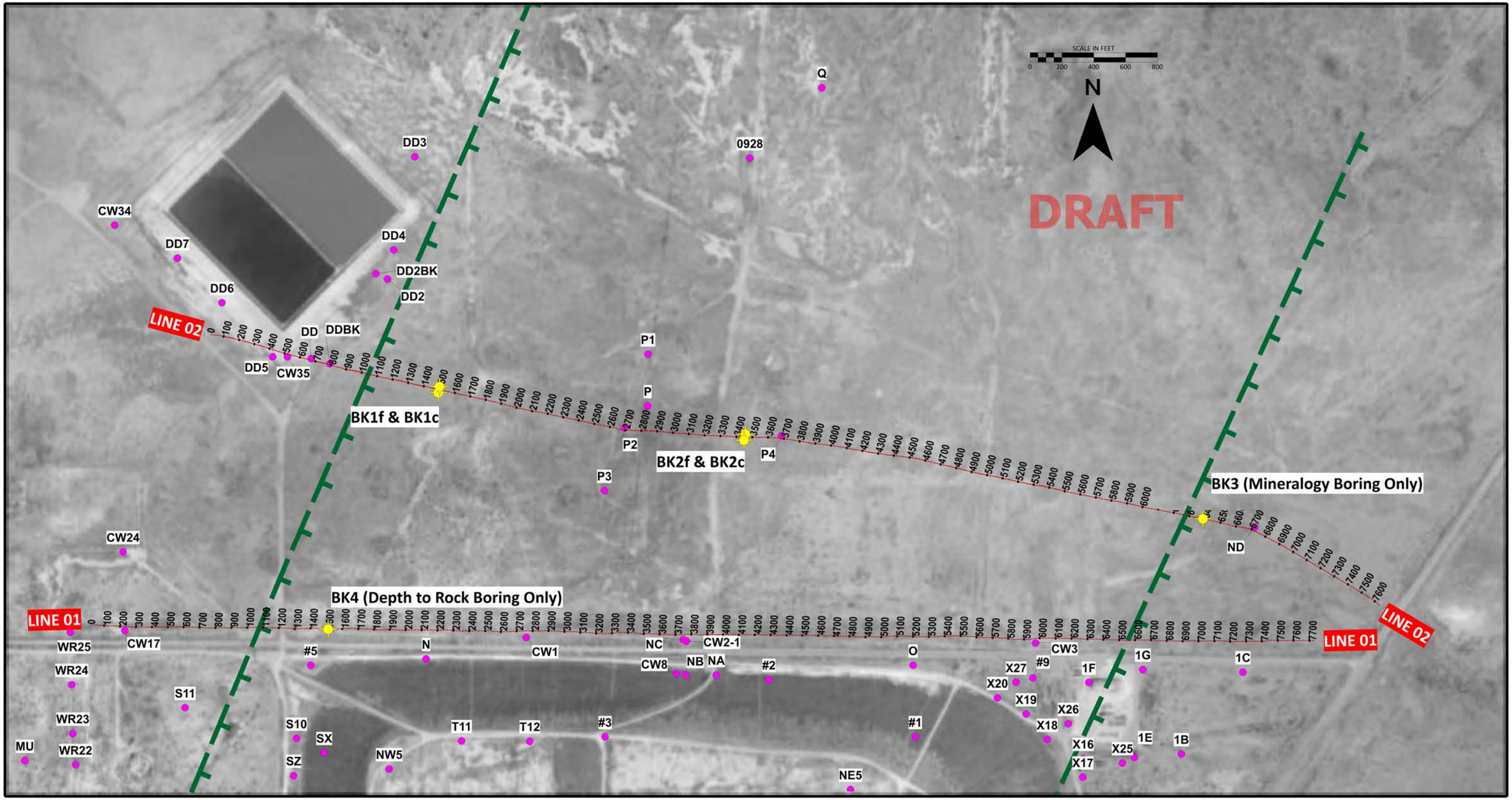
- Each ERT setup utilized a maximum of 112 electrodes with 6-meter (19.7-foot) inter-electrode spacing. The imaging depth of this configuration achieved a maximum penetration depth of approximately 400 feet below ground surface (bgs). For each line there were six overlapping data collection set ups.
- A SuperSting R8™ resistivity meter manufactured by Advanced Geosciences Inc. was used to collect ERT data.
- A combined dipole-dipole and strong gradient array type was used to collect ERT data. These combined arrays provided an optimal horizontal and vertical sensitivity required to capture the complexities of the stratigraphic environment.
- Following field data collection, the apparent resistivity data were compiled and inverse-modelled to create an electrical resistivity tomogram, the results of which are included in continuous cross-sections of the alluvial channel (**Figures 2 through 5** [drafts]). Two renditions of the modeling results are provided. **Figures 2 and 4** are compressed cross-sections of Lines 1 and 2 at a 5:1 vertical exaggeration, intended to provide the "big picture" view of the overall setting including depiction of a significant portion of the Chinle Formation. **Figures 3 and 5** are expanded sections with no vertical exaggeration intended to reveal greater details in the alluvial sediments without the distortions introduced by vertical exaggeration. The RES2DINV software program by Geotomo Software was used to inverse-model the ERT data.
- The results of the geophysical resistivity tomography have been preliminarily reviewed and interpreted, including comments from the U.S. EPA and the NMED, to select the locations of two new monitoring well pairs, the locations of which are shown on **Figures 1, 2 and 3** (drafts). These well pairs are designated BK1c/BK1f and BK2c/BK2f. Per the work plan, one well in each pair will be screened in coarse material while the second will be screened in fine grained materials.
- Two additional locations are also depicted for soil borings designated BK3 (**see Figures 1, 2 and 3)** and BK4 (**Figures 1, 4 and 5**). BK3 is intended to provide primarily lithologic and mineralogic information in the eastern portion of the valley where there appears to be a sediment type/source which differs significantly from the western channel. BK4 is a soil boring which is primarily intended to fill a data gap related to the possible existence of a bedrock high area, indicated by Boring #5 as described by Chavez.
- The rationale for the selection of the locations of the two proposed pairs of wells (BK1 and BK2) incorporated the following key points:
  - General interpretation of electrical resistivity tomogram data
    - Electrical Resistivity Tomograms are modeled, 2-dimensional data sets that are calibrated to the apparent resistivity data collected in the field and which are considered a possible depiction of the internal structure of the subsurface in terms of the resistance to the ability of the subsurface to support electrical current flow. The assumption is that the primary mode of conduction is through interconnected pore spaces in the fluid filling the pores (air, water, or a mixture of both). Except for clay minerals and sulfide minerals, the solid mineral or lithic fragments making up the bulk of the geologic material are extremely poor electrical conductors and do not participate significantly in the flow of electrical current.
    - The principal variables which control the electrical resistivity of the subsurface are:

        - Amount of interconnected porosity
        - Degree of water saturation within the interconnected pore spaces
        - Electrical resistivity of the fluid phase (groundwater) within the pore spaces
        - Grain related factors such as roundness, orientation, elongation, etc.
        - Pore space related factors such as tortuosity, coatings, cementation, etc.
    - For clastic alluvial sediments in fresh water environments electrical resistivity is primarily directly proportional to the coarseness and lack of fines in the alluvium. Conversely, the least resistive materials are those which consist of clay, silt or a mixture of both.
    - Unsaturated alluvium of a particular grain size is more electrically resistive than its saturated counterpart. Because of the ability of fine-grained materials to sorb water, the contrast between unsaturated and saturated fine materials is less pronounced than coarse grained materials.
    - Clay minerals possess a net negative surface charge and have the capacity to attract and hold cations, which under current flow act to facilitate current and lower the electrical resistivity.
- Site specific correlations and interpretations relevant to selection of well locations
    - The approximate current potentiometric surface for the alluvial aquifer and the base of alluvium from drilling observations have both been depicted on **Figures 2 through 5** (drafts).
        - In high resistivity alluvium (yellow to red colors), which is interpreted as coarse-grained materials such as sand or gravel, there is generally a vertical decrease in the electrical resistivity below the potentiometric surface. This change in resistivity may be related primarily to saturation rather than an increase in fine-grained materials.
        - The approximate base of alluvium from drilling observations appears to coincide with a vertical decline in electrical resistivity in the majority of the cross sections, which is interpreted to be fine-grained Chinle lithologies. There are exceptions where moderate to high resistivity material appears beneath the alluvium, which has been confirmed as Chinle sandstone lithologies (for example, see **Figures 4 and 5** [draft] west of horizontal position of 700 feet).
    - Broadly speaking, on both cross-sections the amount of coarse grained (resistive) material is generally to the west side – west of 3100 on Line 1 and west of 4500 on Line 2. The balance of the eastern sides of both lines is a low to moderate resistivity material interpreted as being dominated by fine-grained materials. Close comparison of descriptive logs and geophysical logs for alluvial wells on Line 2 supports the finding that the west side contains sediments much coarser than the east side (for example, compare Well DD with Well ND).
    - Regarding the conditions in the vicinity of Well DD and Boring DD-BK **(Figures 4 and 5** [draft]), the electrical resistivity indicates that there is predominantly coarse-grained materials within the specific drilling locations, although the pod of coarse material is surrounded beneath and to the west and east by finer-grained materials (green).
    - Using the DD/DD-BK environment as an analogue for the type of depositional conditions that are of interest to this background study, locations of BK1 and BK2 are positioned within resistive materials that are also surrounded by finer-grained materials. It is anticipated that sufficient coarse and fine-grained intervals will exist within the saturated alluvium to select both a fine-

grained and coarse-grained well screen location. Evaluation of the ERT profile to identify sufficient coarse and fine-grained intervals to establish screened-intervals (5 to 10 feet in length) in each was used a primary criterion for selection of the borehole locations.

- BK2 is located near well P4 in the center of the alluvial basin to provide a dataset collected from the alluvial column near the deepest part of the alluvial channel.

- Other observations of interest
  - Chinle shale appears to have a very low resistivity value, consistent with high clay content associated with distal facies such as lacustrine and lacustrine-deltaic environments.
  - The west and east faults are placed on the cross-sections from site mapping work in the past. Based on the observations from the Chinle wells and the correlations with the electrical resistivity, the locations of the faults appear to be supported by the electrical resistivity results, although the data are complex, and the exact positions of the faults may need to be revised. Further, the complexity of the data in the Chinle Formation suggests that there may be additional faults.
  - There appears to be a coarsening in alluvial sediments on the down-thrown sides of both the east and west faults, suggesting continued activity of the faults during deposition of the alluvium.
  - The thalweg (lowest point) of the alluvial valley does not appear to coincide with the greatest concentration of coarse sediments on the west side of the valley. The centroid of the highest resistivity materials on Line 2 are off-set approximately 1100 feet west of the thalweg, and perhaps over 2000 feet of off-set on Line 1.



2019 BACKGROUND ASSESSMENT
GRANTS RECLAMATION PROJECT
GRANTS, NEW MEXICO

SITE BASE MAP
ELECTRICAL RESISTIVITY TOMOGRAPHY
ASSESSMENT

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

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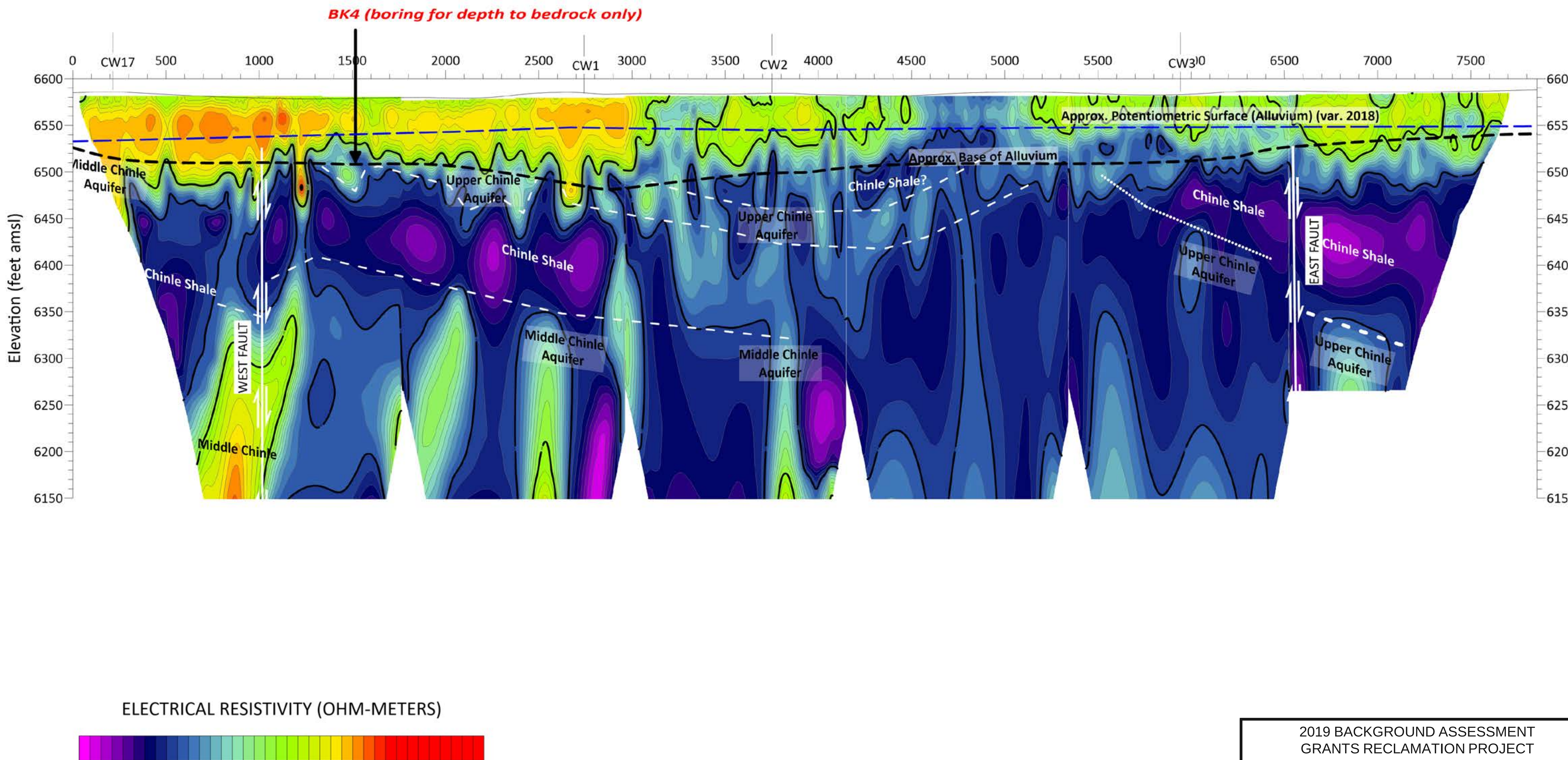
2019 BACKGROUND ASSESSMENT
GRANTS RECLAMATION PROJECT
ELECTRICAL RESISTIVITY LINE 1



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2019 BACKGROUND ASSESSMENT
GRANTS RECLAMATION PROJECT
GRANTS, NEW MEXICO

RESISTIVITY LINE 1 – COMPRESSED VIEW ELECTRICAL RESISTIVITY TOMOGRAPHY ASSESSMENT

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FIGURE
2

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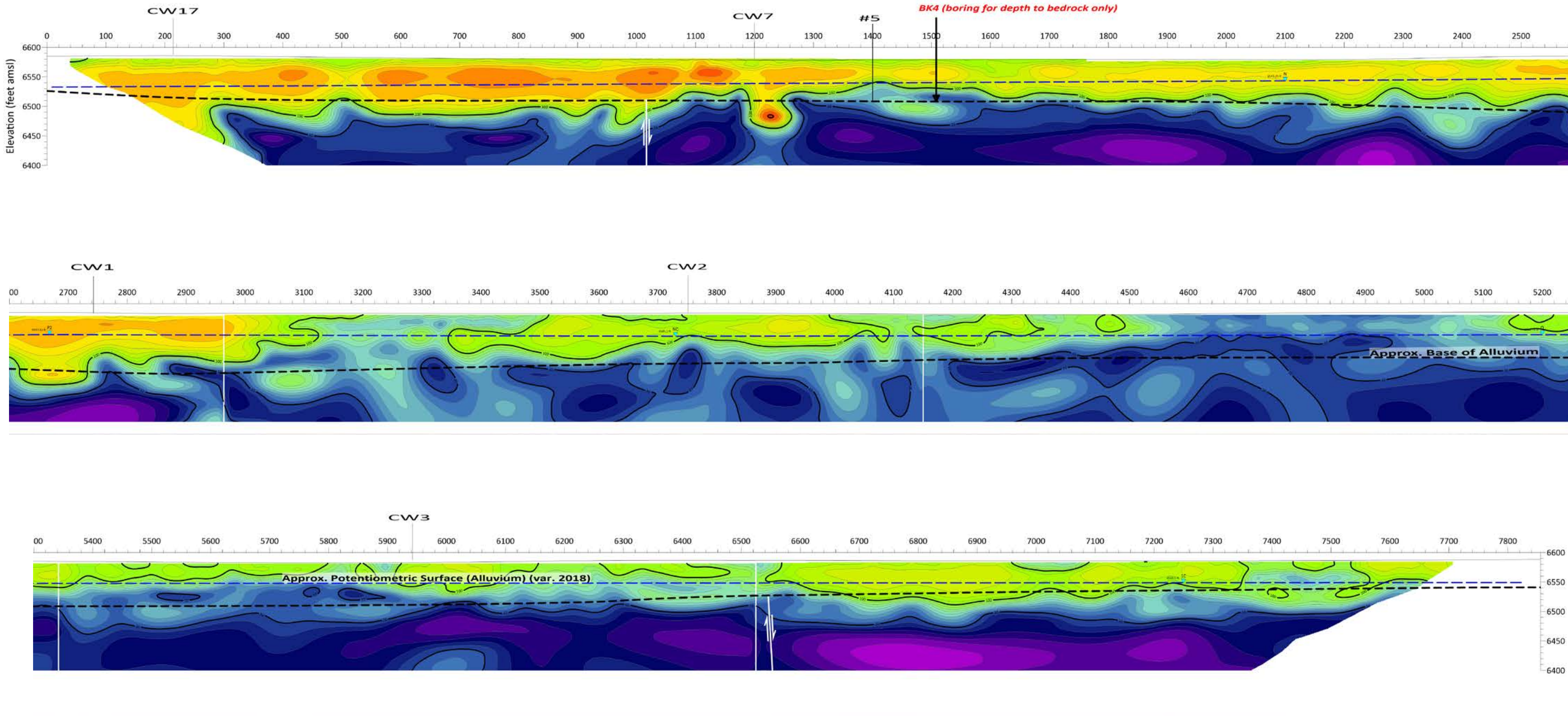

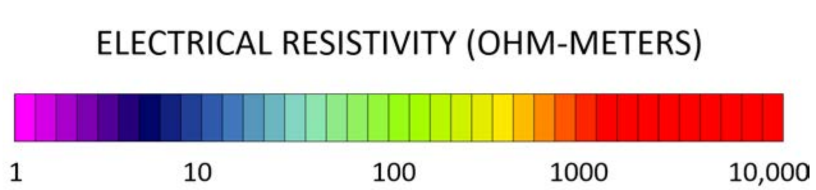

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2019 BACKGROUND ASSESSMENT
GRANTS RECLAMATION PROJECT
GRANTS, NEW MEXICO

RESISTIVITY LINE 1 – EXPANDED VIEW ELECTRICAL RESISTIVITY TOMOGRAPHY ASSESSMENT

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FIGURE 3

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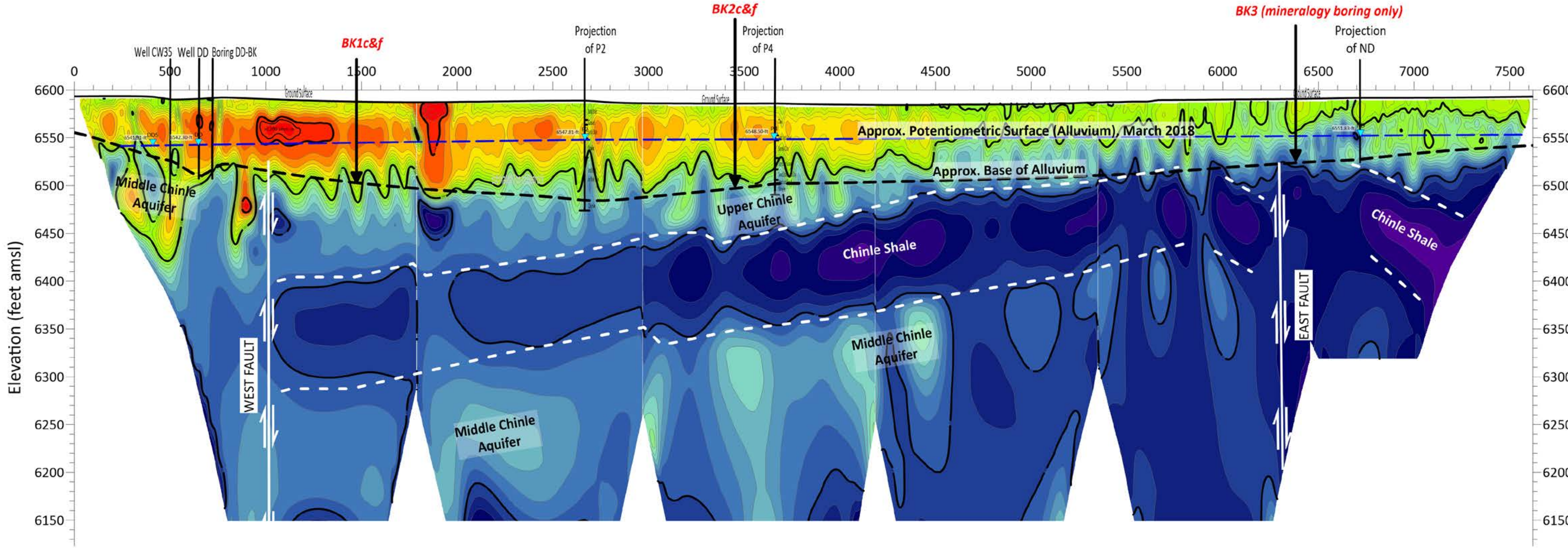
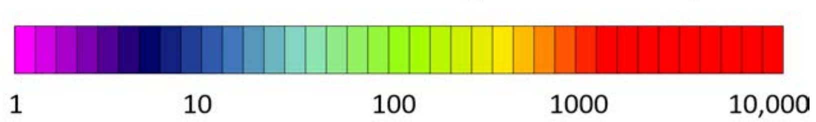
ELECTRICAL RESISTIVITY LINE 2



ELECTRICAL RESISTIVITY (OHM-METERS)



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GRANTS RECLAMATION PROJECT
GRANTS, NEW MEXICO

RESISTIVITY LINE 2 – COMPRESSED VIEW ELECTRICAL RESISTIVITY TOMOGRAPHY ASSESSMENT

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FIGURE
4

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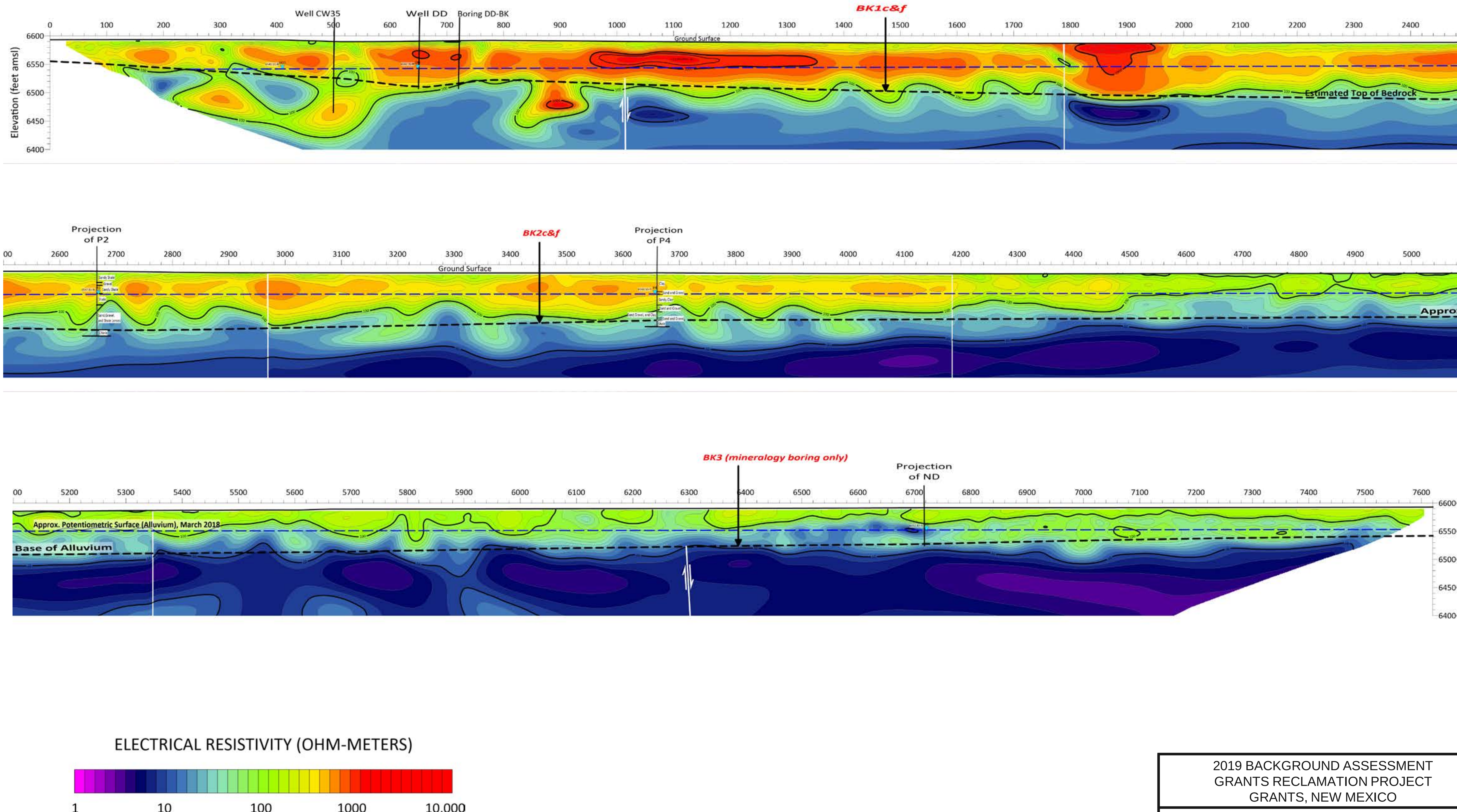

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2019 BACKGROUND ASSESSMENT
GRANTS RECLAMATION PROJECT
GRANTS, NEW MEXICO

RESISTIVITY LINE 2 – EXPANDED VIEW
ELECTRICAL RESISTIVITY TOMOGRAPHY ASSESSMENT

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FIGURE
5

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